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# Update on the Status of Unit 3 Redfish, 1999

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## Abstract

This document summarizes commercial fishery and research survey data for Unit 3 (4Wdehkl and 4X) redfish to October 1999. Recent landings were slightly lower than the average of the previous 4 years and well below the TAC. Most of the reported catch for the period 1998-99 (to Oct) was taken by small otter trawlers (<65'), fishing almost entirely in the Crowell and Jordan basin portions of the Gulf of Maine. Fishing success of small otter trawlers in LaHave and Emerald basins improved in 1999 over 1998, mainly due to the discovery of new fishing locations in that area. Catch rates of larger redfish was consistently good and small redfish were generally avoided. The 1999 survey biomass estimate was judged to be not greatly different than average since the late 1980s. Indications of small redfish continue in the area north and east of Brown's Bank. Catches of about 10,000t in 2000/01 would probably not exceed $F_{0.1}$. The present exploitation rate is fairly low, thus there is no biological or fishery basis to suggest a need for change in the management of the resource at this time.



## Résumé

Le présent document résume les données obtenues de la pêche commerciale et des relevés de recherche pour le sébaste de l'unité 3 (4Wdehkl et 4X) jusqu'en octobre 1999. Les débarquements récents étaient légèrement inférieurs à la moyenne des quatre années antérieures et bien en deçà du TAC. La majorité des captures signalées pour la période 1998-1999 (jusqu'en octobre) ont été effectuées par de petits chalutiers (<65 pi.) presqu'exclusivement dans les bassins Crowell et Jordan du golfe du Maine. Le succès de pêche des petits chalutiers dans les bassins LaHave et Emerald s'est accru en 1999, comparativement à 1998, surtout à cause de la découverte de nouvelles aires de pêche dans cette zone. Les taux de capture de sébastes de plus grande taille étaient constamment élevés et les poissons de petite taille étaient généralement évités. La biomasse estimée par le relevé de 1999 ne différait pas de façon appréciable de la moyenne obtenue depuis la fin des années 1980. On note encore la présence de petits sébastes dans la partie nord et est de Brown's Bank. Un niveau de capture de 10 000 t en 2000-2001 ne serait sans doute pas supérieur à la valeur du F0.1. Le taux d'exploitation actuel est passablement faible et il n'y a donc pas de justification biologique ou halieutique de modifier la gestion de cette ressource pour le moment.

## Introduction

Redfish, also known as ocean perch occur on both sides of the Atlantic Ocean. They are normally found along the slopes of fishing banks and deep channels usually at 100 - 700 m in water of 3 to 8 ° C. In the northwest Atlantic, redfish range from Baffin Island in the north to New Jersey in the south. The predominant species on the Scotian Shelf are *Sebastes fasciatus* (Acadian redfish), occurring in the deep basins and at the edge of the continental shelf, and *S. mentella* (beaked redfish) occurring in the deeper waters off the continental shelf. Differences between these two species are not readily apparent, therefore commercial and research catch are not routinely separated by species.

Redfish are ovoviviparous as fertilization is internal, and the young are born live. Mating occurs in the fall and females carry the developing young until release from April to July of the following year. Redfish in general are slow growing and long lived, with ages of >30 years and sizes of >50 cm (weight of about 2.5 kg) having been observed. The young grow to about 8 cm in their first year of life and then take 8-10 years to reach a commercial size of 25 cm (weight of about 300 gm). *S. fasciatus* reaches a smaller size than *S. mentella*. Growth is usually faster in southern areas than in northern areas, and females grow faster than males. The average length at which 50% of redfish on the continental slope of 4WX (Ni and Sandeman 1984) are mature is about 24 to 26 cm for females and 16 to 17 cm for males. In the Gulf of Maine (Mayo *et al.* 1990) it is about 22 cm for females and 19 to 22 cm for males.

Redfish are semipelagic; feeding is thought to take place at night, when redfish rise off the bottom. Food consists primarily of pelagic crustaceans such as amphipods, copepods, and euphausiids. Fish become an increasingly important part of the diet as redfish increase in size.

Management Unit 3 (Fig. 1) for redfish consists of Statistical Unit Areas 4Wdehkl and 4X. The fishery is primarily conducted using bottom otter trawls (OTB) with small mesh cod ends (90-100 mm). Assessment and management strategies used for this, and other Canadian redfish stocks, have been the same as for other groundfish; the $F_{0.1}$ reference level has been assumed to approximate an exploitation rate of about 12%.

New genetic research results presented at a special workshop just prior to the Zonal Redfish assessment meeting confirm that Unit 3 redfish are almost exclusively *S. fasciatus* and belong to a separate stock from *S. fasciatus* in Units 1 and 2 (no references at this time) . There is also an indication of a genetic separation between Scotian Shelf and Gulf of Maine populations. The new information, however, needs to be more closely examined, and additional research may be required, before its full implications with regard to stock structure in Unit 3 are understood.

## Materials and Methods

### Commercial Data

Landings by domestic vessels were taken from North Atlantic Fishing Organization (NAFO) files for 1977-94 and from Department of Fisheries and Oceans (DFO) Zonal Interchange Format (ZIF) files for 1977-99. The NAFO data were reported by Division and since Unit 3 contains only a portion of Div. 4W, only the Div. 4X data from the two sources were compared. They agreed almost exactly, therefore the ZIF data were considered to accurately reflect the landings and were used to estimate Canadian landings for the entire management unit.

Landings by foreign vessels were available from NAFO files for 1977-93 and from Canadian Observer (Observer) files for 1988-99 when there was 100% coverage of foreign vessels. The NAFO data were compared to Div. 4X landings for 1988-93 and found to agree fairly well, therefore NAFO data from Div. 4X for the period 1977-87 and Observer data from the entire management unit for the period 1988-99 were combined to estimate foreign landings.

ZIF and Observer data were summarized by fishing area as defined by Statistical Unit Areas:

| | |
|---|---|
| Emerald and LaHave Basins | 4WdehkXm |
| Roseway Basin and Western Ridge | 4Xo |
| Scotia Shelf slope | 4WlXn |
| Crowell and Jordan Basins | 4Xpqrs |

The distribution of Canadian catches were described in the form of maps from the ZIF data using geographical coordinates, available for 1996-99 and aggregated into 20 minute squares.

The size composition of Canadian landings was estimated from port samples obtained by the National Sampling Program (NSP) and from sea samples obtained from the Observer Program for 1994-99. Sample weights from both sources were estimated using a length-weight relationship obtained from the summer Research Vessel survey, 1970-94 combined (Branton and Halliday 1994). The equation was:

$$W = .0142\ L^{3.09}$$

Port length frequency samples were adjusted to landed weight. Length frequency samples collected at sea on trips where more than one cod end was used were assumed to be gear trials and excluded from the analysis. The remaining sea samples were adjusted to individual tow weight, then combined and adjusted to landed weight for each fishing area. Port and sea samples were combined by fishing area.

Bycatch of other groundfish were taken from ZIF 1989-99 and Observer files for 1998-99. From the ZIF files, only those trips where redfish was the main species landed were used and from observer files, only those tows where redfish was the species sought as determined by the observer before the tow were used. Catch weights of other groundfish from both sources were summarized by fishing area and vessel class and then divided by the redfish catch weight. The Observer catches were very low for 1998-99 (<10%) and did not agree well with ZIF. Thus, ZIF data only were used to estimate bycatch of other groundfish species.

Fishing effort analysis was based on ZIF records; selection of trips was limited to those in which redfish was main species landed; effort hours and days fished were summed by year and average hours per day were calculated for the period 1989-99.

**Research Data**

Estimates of population biomass, abundance, distribution and size structure were from the stratified-random Scotia Fundy summer research vessel (RV) survey (strata 456, 458-495). The surveys have been conducted on the Scotian Shelf (<200 fm) from 1982-99 using the Alfred Needler (Branton and Black 1999). Starting in 1995, this survey was enhanced to include redfish species identification techniques and extended to include the Scotian Shelf Slope (2-400 fm, strata 496-498) in order to cover redfish habitat at the shelf edge previously not covered by the survey. These deep strata have a small area and do not affect population size estimates strongly (Zwanenburg and Hurely 1987). Given this limited effect and the extended survey coverage has only 5 of 16 years, the biomass and abundance estimates were derived from the Scotian Shelf only. Distribution and size composition estimates however were derived from the Scotian Shelf and the western Scotian Shelf Slope (stratum 498).

An industry survey, conducted in July by the ITQ fleet (ITQ survey) in Div. 4X, using a fixed station design, also provided estimates of the population distribution and abundance for 1995-99. Some redfish size composition samples were available from these surveys, however not all tows were sampled for length. Spatial coverage of the ITQ survey differed from the RV survey: the ITQ survey did not include areas on Scotian Shelf Slope between 2-400 fathoms (stratum 498); the ITQ survey included coastal areas (stratum 499) not covered by RV survey; and in 1995 fewer strata were occupied by the ITQ survey than in 1996-99. Distribution from both surveys was similar in all years.

Biomass and abundance estimates for stratum common to RV and ITQ surveys agreed in 1995 and 1996, but were higher in 1997 as a result of large catches of small redfish (.18 kg average) in the Roseway Basin and Western Ridge area (stratum 476 and 481). The 1997 RV estimates were much higher than in the ITQ survey as a result one large catch (stratum 476) of small redfish. Biomass and abundance estimates were lower in the common strata for both surveys in 1998 than in 1997. The 1998 RV survey estimates were much lower than the ITQ survey estimates as a result of no sets being allocated to the RV survey in and around Roseway Basin and Western Ridge areas in that year. The

1999 estimates are amongst the highest values for both surveys. Analysis of results from the ITQ survey are provisional.

United States (US) stratified random groundfish trawl survey data were taken directly from the US National Marine Fisheries Service (NMFS) survey database. The 1982-98 mean number and weight per tow and size compositions estimates were calculated for strata 24, 26-30 and 36-40 using the Stratified Analysis Program for US data (STRAPUS) at the Saint Andrews Biological Station (SABS). These are same strata used for US Northeast Regional Stock Assessments (Mayo 1993).

## Results

### Description of the Fishery

The Unit 3 management area for redfish was first implemented in the 1993 Groundfish Management Plan. Redfish in this area were previously managed as part of a larger 4VWX management area. The 10,000 t Total Allowable Catch (TAC), introduced in 1993 was based on 1991 TACs for the previous management unit prorated by historical (1981-90) catches in the Statistical Unit Areas which comprise Unit 3. The first scientific description of Unit 3 redfish was a report to the Fisheries Resource Conservation Council (FRCC) in autumn 1993 which was used as a basis for a recommendation for the 1994 TAC also of 10,000 t (FRCC 1993). The 1994-97 stock status reports (Branton and Halliday 1994, Branton 1995, Branton 1996, and Branton 1997) all concluded that fishing and stock conditions in coming years were not expected to differ greatly from those in recent years. As a result, the TACs for 1995-98 were all set at 10,000 t. The 1999 stock status report indicated that reduced commercial success in the eastern portion of the management unit and concentration of effort in the west would justify extra caution in the management of this resource. The FRCC subsequently recommended a 9,000 t TAC for 1999. This TAC was later adjusted to 9,450 t in order to accommodate transition to an April-March fishing year starting in the year 2000.

Annual redfish landings from Unit 3 (Table 1, Fig. 2) gradually increased from the late 1970s, peaking at almost 7,000 t in 1986 followed by a decline to about 2,000 t in 1991. Landings peaked again in 1997 at about 6,000t. Landings for 1998 were about 5,800t. All catches were well below the 10,000 t TAC. The 1999 provisional catch to the end of October was about 4,100 t. This is somewhat lower than for same period in 1998 (5,000 t).

Most of the Unit 3 redfish landings during the period 1977-89 were from Emerald and LaHave Basins (4WXdehkm), with the Roseway Basin and Western Ridge (4Xo) accounting for most of the remainder (Table 2, Fig. 3). During the period 1992-97, landings were generally distributed among the four fishing areas of the management unit. In 1997 there were increased landings from the Scotian Shelf Slope (4WXln)(Fig 4.) while in 1998 and 1999 (to July) much of the landings were from the Crowell and Jordan

Basins (4Xpqrs). In 1998, the highest landings were in the May to July period as was the case in 1994-97 (Table 3-5). In 1999 (to July), landings were highest in May (1,203 t).

Large otter trawlers (>65 ft, TC 4+5) accounted for most of the Unit 3 redfish landings during the period 1977-92. More recently most of the landings have been by small otter trawlers (<65 ft, TC 2+3) (Table 6, Fig. 5). In 1999 (to July), almost all of the landings were by small otter trawlers. The redfish allocation to small otter trawlers was included in the Individual Transferable Quota (ITQ) management program for this fleet component starting in 1996 (Annand and Hansen 1997). In 1998, 88% of the inshore (<65 ft) quota allocation was caught (down from 96% in 1997) while the mid-shore (65-100 ft) utilization was about 5% and the off-shore (>100 ft) utilization was 67%. Almost all of the off-shore allocation was caught by small otter trawlers under the Temporary Vessel Replacement Plan (TVRP) (Table 7), thus the discrepancy between quota and landings reports by vessel class.

Unit 3 redfish landings have traditionally had a high proportion of fish in the 20-25 cm range and port samples for the period 1984-93 indicate that landings of smaller redfish were rare. Increased catches of fish less than 20 cm in 1994-95 occurred in an area north and east of Brown's Bank known as the 'Bowtie' (Fig. 6). At industry's request, this area was closed to fishing with small mesh gear (<130 mm) on May 19, 1995 and a 22 cm minimum fish size was included in Conservation and Harvesting Plans (CHP) for 1996-99. Following FRCC recommendations, the boundaries of the 'Bowtie' small redfish protection area were redefined in early 1998. ITQ and RV survey catches in this area during the summer of 1999 suggest that the proportions of small fish are slightly reduced from the year previous but still remain high. Percentages by number of commercial redfish landings from the management unit as a whole under 22 cm were:

| | 93 | 94 | 95 | 96 | 97 | 98 | 99 (to July) |
|---|---|---|---|---|---|---|---|
| % < 22 cm | 4 | 15 | 15 | 10 | 6 | 7 | 6 |

The proportions of small redfish (<22cm) were highest in commercial samples from Roseway Basin and Western Ridge in 1994-96 (Fig 7). Small redfish in catches from that area declined after 1996. Commercial activity in this area during 1999 (to July) was very low, and there were no port or observer samples(Table 8-10). The proportions of very small redfish from Crowell and Jordan Basins samples were high only in 1997, the same time when the proportions of large redfish (>35cm) from that area were low. Large redfish were not evident in the 1999 samples (Fig. 8). The proportions of large redfish have been consistently high in the catches from the Scotian Shelf slope (Fig. 9). Catches from Emerald and LaHave Basins in 1994-98 contained mostly commercial sized redfish (20-35 cm), although in 1999, there was some evidence of small redfish (Fig. 10).

Bycatch of other groundfish species in the directed redfish fishery (< 130 mm sq. mesh cod end) has also been cited as a problem in recent years. In addition to limits of 2% each of cod and haddock (as a percentage of redfish catch) in 4VW and 10% of all other

groundfish species in 4X, DFO Operations also implemented a number of other areas were closed to redfish fishing to avoid bycatches of other species. These closures include:

| Area | Period |
|---|---|
| 4W | Jan 01-Jun 30 |
| Haddock Nursery | All year |
| Brown's Bank | Jan 01-Jun 30 |
| Bay of Fundy N. of 43°30' | All year |
| All areas < 50 fathoms | All year |

'Test Fishing' and mandatory observer coverage were required before the start of fishing for redfish in NAFO Divisions 4VW in 1996-99. Fleet sectors were controlled separately. Vessels fishing under offshore license conditions (including TVRP vessels) were permitted to test the area open beginning January 1, while the area was closed to the <65' mobile gear fleet (ITQ) from January 1 to June 30 (based on license conditions). Test fisheries, particularly in Area 1 portion of Div. 4W resulted in sporadic closures throughout the period due to a combination of high bycatch and incidence of small fish, especially pollock.

The percent bycatch of all other groundfish species combined, in the Unit 3 redfish fishery was about 12% for 1997, 15% for 1998 and almost 18% for 1999(to July)(Table. 11-13). These bycatches consisted mostly of pollock and haddock, which has increased steadily since 1994. Highest rates of all species combined were in Crowell and Jordan Basins (22.2% in 1999). Neither industry nor management consider the situation to be a problem because most of the bycatch consisted of legal sized fish and was counted towards the vessels' quota of these species. Observer data for 1998-99 show much higher bycatch rate for pollock in Crowell and Jordan basins than do commercial statistics but these data are too limited to allow extrapolation to the fleet as a whole (Table 14). There were no observer data from Crowell and Jordan basins for 1997.

**Resource Status**

Fishing effort of small otter trawlers and large otter trawlers were examined (Table 15-16). Many changes in the fishery (e.g. many new entrants, small fish closures, bycatch closures, ITQ management and the TVRP) would make resulting catch rates impossible to interpret in the context of overall redfish abundance (Branton and Halliday 1994, Branton 1995). Fishing success of small otter trawlers (Fig. 11) to the eastward (LaHave and Emerald basins) improved in 1999 over 1998, mainly due to the discovery of new fishing locations. The sharply reduced fishing success in Roseway Basin and Western Ridge is due to the reduced effort associated with captains and plant operators avoiding the very small fish in that area. Fishing success along the shelf edge was about the same in 1999 as in 1998 while it did decline slightly to the westward in Crowell and Jordan basins. The continued high proportion of catch to the westward resulted mainly from the sustained concentration of fishing effort there. The extent of area occupied by small otter trawlers directing for redfish (main species caught) has expanded since 1990 (Fig. 12, 13) with some stabilization in the most recent years.

Survey estimates of population (< 200 fm), are highly variable between years (Table 17, Fig 14, 15) but show no trend over time from the late 1980s, (Branton and Black 1999). The 1997 and 1999 abundance estimate are much higher than earlier values and is in part, a reflection of higher availability of small redfish to surveys in the Roseway Basin and Western Ridge fishing area in that year. The low abundance in 1998 is very likely a result of not having any of the RV survey sets allocated to the small fish areas in that year. The proportion of RV survey area containing 75% of redfish biomass (Fig. 16) and the proportion non-zero tows from the survey (Fig. 17) have not changed much since 1995 and are all well above precautionary type targets/limits. Condition factor index (predicted weight of a 25 cm redfish) estimates for the period 1970-99 (Fig. 18) are highly variable between years and there is no data for 1991-94. More recently, this index has been consistently below target but above the precautionary limit.

The ITQ survey in 4X provides biomass estimates similar to the RV survey for that area (Fig 19, Table 18) , but the estimates are less variable. The ITQ survey indicates abundance in 1998 (unlike the RV survey) was similar to the previous three years. The 1999 abundance estimates are amongst the highest values for both surveys. Analysis of results from the ITQ survey are provisional.

USA surveys of the Gulf of Maine and Georges Bank, which include Crowell and Jordan basins(Fig 20-21), have shown a major increase in resource abundance in 1996-98 (Fig 22). Although these surveys obtained much higher catch rates in 1996-98 than previously, the trends in size composition are inconsistent with the interpretation that this resulted from increased recruitment to the fishable stock (Fig 23). These data require more detailed examination before much weight is put on them to determine Unit 3 resource abundance.

The size composition of surveys catches 1994-99 differs for each of the fishing areas. (Fig. 7-10). There are however small redfish (<22 cm) in all fishing areas and appear to have been avoided by the commercial fishery. The smallest redfish (modal length 20-22 cm) on average for the period 1994-99 were in the Roseway Basin and Western Ridge fishing area where avoiding small redfish has been most difficult. The RV size composition on the Scotia Shelf Slope shows evidence of the larger commercial fish (>30 cm) only after 1994 when the survey was extended beyond 200 fm, suggesting that the newly extended survey does cover more Unit 3 redfish habitat than in the past. The size composition of survey catches for Unit 3 overall <200 fm (Fig. 24) provides some evidence of small redfish (< 22 cm) entering the population as well as an overall decline in modal size of the population since about 1987. In 1993-99 there are indications of more small redfish than in the past, a large proportion of which, since 1995, have been 20-22 cm long (Fig. 25) and found in the Roseway Basin and Western Ridge fishing area.

**Industry Perspective**

Several captains who had successfully fished for redfish in recent years were no longer doing so because of reduced demand at the processing plants for small redfish commonly found in Unit 3. Most captains of small otter trawlers remain concerned over the continued concentration of fishing effort in Crowell and Jordan basins in 1999. They also indicated that commercial redfish success for this area is closely related to spiny dogfish bycatch rates. Dogfish bycatch rates tend to be low when bottom water temperatures are low as was the case in 1998. High dogfish bycatch rates have a tendancy to wreck commercial redfish fishing gear and are usually avoided. Dogfish can be legally discarded and are thus generally not recorded in the ZIF statistics.

Active captains indicated that the catch rates of market sized redfish in 1999 were not as good as in 1998, resulting in higher bycatch rates of other commercial species. Captains were not as concerned as in 1998 over the lower catch rates encountered in the eastern part of the management unit (Emerald and LaHave basins) as they were able to find some new areas of good fishing.

Some captains claim that small mesh gear fishing could be safely extended northward from 43° 30' to 43° 40'. Most captains have responded favorably to the 'Bowtie' closed area revisions particularly since processing plants will pay little or nothing for very small redfish.

## Discussion

The increase in catches after 1992, resulted from an increase in fishing effort by small otter trawlers, reflecting decreased fishing opportunities for more valuable species, and not an increase in redfish abundance. The decrease in catches since 1997, resulted from a decrease in effort by these same vessels, reflecting decreased demand at the processing plants for the smaller fish and not a decrease in redfish abundance.

Redfish smaller than commercial size do not contribute greatly to this biomass estimate, so survey biomass can be taken as an indicator for the size classes fished commercially. However, survey biomass underestimates the actual biomass on which the commercial fishery is based, as not all of the commercial sized fish are available to the survey gear, and some are outside the survey area (deeper than 200 fm). The ratio of catch tonnages (~5,000 t) to recent (5 yr average) survey biomass (~65,000 t) gives an estimated exploitation rate of about 7 percent for the period 1986-96 and 9 percent for the period 1994-98 (Table 19). A catch at the current 10,000 t TAC would therefore result in an exploitation rate of about 15% which would be an over estimate of the actual exploitation rate. RV surveys indicate stability in the population biomass with increased catches of small redfish (20-22 cm) north and east of Brown's Bank. It is not yet clear to what extent the small redfish being observed will increase exploitable biomass and hence improve fishing success.

## Conclusion

The exploitation rate is fairly low and there is no biological or fishery basis to suggest a need for change in the management of the resource at this time.


## Acknowledgments

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**Table 1. Unit 3 redfish Canadian and foreign landings and TAC by year in Thousands of Tons (as of Nov 3, 1999).**

| Year | Cdn | Fgn | Total | TAC | |
|---|---|---|---|---|---|
| 1977 | 2.11 | 2.29 | 4.40 | | |
| 1978 | 1.20 | 2.02 | 3.22 | | |
| 1979 | 1.86 | 0.72 | 2.58 | | |
| 1980 | 2.87 | 0.89 | 3.76 | | |
| 1981 | 3.73 | 0.76 | 4.49 | | |
| 1982 | 3.09 | 1.58 | 4.67 | | |
| 1983 | 4.04 | 0.82 | 4.86 | | |
| 1984 | 4.57 | 0.87 | 5.44 | | |
| 1985 | 5.84 | 0.03 | 5.87 | | |
| 1986 | 6.62 | 0.06 | 6.68 | | |
| 1987 | 6.07 | 0.02 | 6.09 | | |
| 1988 | 3.90 | 0.04 | 3.94 | | |
| 1989 | 3.20 | 0.19 | 3.39 | | |
| 1990 | 2.26 | 0.12 | 2.38 | | |
| 1991 | 1.92 | 0.13 | 2.05 | | |
| 1992 | 2.37 | 0.12 | 2.49 | | |
| 1993 | 5.08 | 0.19 | 5.27 | 10.0 | |
| 1994 | 5.17 | 0.01 | 5.18 | 10.0 | |
| 1995 | 4.83 | 0.02 | 4.85 | 10.0 | |
| 1996 | 4.77 | 0.03 | 4.80 | 10.0 | |
| 1997 | 6.30 | 0.05 | 6.35 | 10.0 | |
| 1998 | 5.78 | 0.01 | 5.79 | 10.0 | |
| 1999 | 3.71 | 0.01 | 3.72 | 9.0 | (to Oct) |

**Table 2. Unit 3 redfish Canadian landings (tons) by year and statistical area.**

| Year | dehkm | ln | o | pqrs | u | Unit3 | |
|---|---|---|---|---|---|---|---|
| 1977 | 1118 | 598 | 162 | 117 | 120 | 2114 | |
| 1978 | 544 | 386 | 210 | 37 | 24 | 1201 | |
| 1979 | 1067 | 360 | 353 | 75 | 8 | 1864 | |
| 1980 | 1212 | 783 | 797 | 70 | 12 | 2874 | |
| 1981 | 2480 | 279 | 905 | 34 | 34 | 3731 | |
| 1982 | 1005 | 420 | 1508 | 139 | 18 | 3090 | |
| 1983 | 2314 | 519 | 935 | 193 | 83 | 4044 | |
| 1984 | 3156 | 473 | 565 | 167 | 210 | 4570 | |
| 1985 | 3961 | 329 | 1061 | 152 | 342 | 5844 | |
| 1986 | 2416 | 1197 | 1978 | 363 | 668 | 6623 | |
| 1987 | 2412 | 849 | 1451 | 213 | 1143 | 6067 | |
| 1988 | 1096 | 594 | 376 | 118 | 1718 | 3903 | |
| 1989 | 1231 | 321 | 137 | 172 | 1343 | 3205 | |
| 1990 | 291 | 128 | 348 | 122 | 1374 | 2262 | |
| 1991 | 363 | 135 | 547 | 82 | 785 | 1912 | |
| 1992 | 716 | 191 | 1114 | 206 | 145 | 2371 | |
| 1993 | 629 | 614 | 2917 | 886 | 29 | 5075 | |
| 1994 | 391 | 972 | 2712 | 1054 | 39 | 5169 | |
| 1995 | 1441 | 466 | 1384 | 1525 | 22 | 4838 | |
| 1996 | 1901 | 320 | 1412 | 1117 | 23 | 4774 | |
| 1997 | 1646 | 1436 | 1177 | 1997 | 53 | 6311 | |
| 1998 | 535 | 471 | 483 | 4289 | 4 | 5783 | |
| 1999 | 512 | 551 | 104 | 2541 | 1 | 3708 | (to Oct) |

**Table 3. Annual average landed tons by statistical unit area grouping and month for mobile gear fishing redfish in Unit 3 for the period 1994 to 1997.**

| AREA | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dehkm | 26 | 28 | 20 | 69 | 281 | 190 | 55 | 213 | 144 | 139 | 48 | 84 | 1296 |
| ln | 0 | 6 | 1 | 74 | 244 | 164 | 156 | 51 | 20 | 19 | 20 | 15 | 770 |
| o | 0 | 0 | 3 | 61 | 228 | 289 | 713 | 234 | 25 | 41 | 15 | 16 | 1625 |
| pqrs | 1 | 5 | 28 | 273 | 258 | 274 | 97 | 38 | 103 | 151 | 28 | 39 | 1296 |
| u | | | | | 0 | 0 | 1 | 0 | 2 | 0 | | | 4 |
| | 28 | 39 | 52 | 476 | 1011 | 917 | 1021 | 536 | 294 | 351 | 112 | 155 | 4991 |
| SA5 | 0 | | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 3 | 3 | 1 | 9 |

**Table 4. Landed tonnes by statistical unit area grouping and month for mobile gear fishing redfish in Unit 3 during 1998.**

| AREA | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dehkm | 19 | 21 | 13 | 23 | 83 | 26 | 14 | 20 | 50 | 143 | 63 | 38 | 515 |
| ln | 8 | 5 | 61 | 176 | 95 | 34 | 13 | | 20 | 10 | 1 | 2 | 425 |
| o | 2 | 3 | 2 | 2 | 44 | | 190 | 65 | 38 | 40 | 19 | 18 | 422 |
| pqrs | 7 | 29 | 462 | 192 | 1183 | 873 | 410 | 456 | 225 | 112 | 41 | 10 | 4000 |
| u | | | | | | | | | | | | 1 | 1 |
| | 36 | 58 | 538 | 393 | 1404 | 933 | 627 | 542 | 333 | 305 | 124 | 69 | 5363 |
| SA5 | | 0 | | 1 | 4 | 69 | 5 | 1 | 1 | 7 | 7 | | 94 |

**Table 5. Landed tonnes by statistical unit area grouping and month for mobile gear fishing redfish in Unit 3 during 1999 (to Nov 3, 1999).**

| AREA | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dehkm | 6 | 1 | 13 | 12 | 16 | 7 | 127 | 311 | | | | | 493 |
| ln | 0 | 7 | 17 | 95 | 404 | 13 | 5 | 2 | 1 | | | | 543 |
| o | 7 | 1 | | 1 | 26 | 16 | 23 | 3 | 5 | | | | 81 |
| pqrs | 3 | 105 | 3 | 161 | 756 | 602 | 307 | 278 | 71 | | | | 2287 |
| | 16 | 114 | 33 | 268 | 1203 | 637 | 462 | 593 | 77 | | | | 3404 |
| SA5 | | | | 10 | 19 | 33 | 1 | 5 | | | | | 68 |
| | | | | 10 | 19 | 33 | 1 | 5 | | | | | 68 |

**Table 6. Unit 3 Canadian redfish catch (thousands of tons) by year and vessel type (main species redfish trips only) and all other catches.**

| Yr | <65' TC2+3 | >65' TC4+5 | Other | Combined | |
|---|---|---|---|---|---|
| 1989 | 1.41 | 1.40 | 0.39 | 3.20 | |
| 1990 | 0.37 | 1.43 | 0.47 | 2.26 | |
| 1991 | 0.44 | 1.06 | 0.41 | 1.92 | |
| 1992 | 0.36 | 1.55 | 0.46 | 2.37 | |
| 1993 | 2.92 | 1.71 | 0.44 | 5.08 | |
| 1994 | 3.84 | 1.01 | 0.31 | 5.17 | |
| 1995 | 3.80 | 0.87 | 0.17 | 4.84 | |
| 1996 | 4.15 | 0.28 | 0.34 | 4.77 | |
| 1997 | 5.88 | 0.11 | 0.31 | 6.30 | |
| 1998 | 5.29 | 0.07 | 0.42 | 5.78 | |
| 1999 | 3.17 | 0.24 | 0.30 | 3.71 | (to Oct) |

**Table 7. Quota allocations and percent used by vessel type for Unit 3 redfish during 1997 and 1999 (to Oct 31, 1999).**

| Year | Vessel | Quota | Catch | %used |
|---|---|---|---|---|
| 1997 | Mobile <65' | 3707 | 3544 | 96 |
| | Mobile 65-100' | 2851 | 269 | 9 |
| | Vessels >100' | 3442 | 2349 | 68 |
| | Total | 10000 | 6262 | 63 |
| 1998 | Mobile <65' | 3707 | 3244 | 88 |
| | Mobile 65-100' | 2734 | 129 | 5 |
| | Vessels >100' | 3559 | 2420 | 67 |
| | Total | 10000 | 5793 | 57 |
| 1999 | Fixed < 65' | 0 | 35 | - |
| (Oct 31) | Mobile < 65' | 3503 | 1978 | 56 |
| | Mobile 65' - 100' | 2489 | 63 | 3 |
| | Vessels > 100' | 2372 | 1524 | 64 |
| | Others | 1086 | 495 | 46 |
| | Total | 9450 | 4095 | 43 |

**Table 8. Number of port samples of redfish landings in Unit 3 by vessel/gear class and by statistical area, and by Div., 1993-99. Inventory for 1999 is incomplete.**

| YEAR | CLASS | dehkm | ln | o | pqrs | 4W | 4X | Unit 3 |
|---|---|---|---|---|---|---|---|---|
| 1993 | OTB 0-3 | | 1 | 3 | 1 | | 5 | 5 |
| | OTB 4+ | 1 | 1 | 1 | | 2 | 1 | 3 |
| **** | | | | | | | | |
| sum | | 1 | 2 | 4 | 1 | 2 | 6 | 8 |
| 1994 | OTB 0-3 | | 1 | 12 | 5 | | 18 | 18 |
| | OTB 4+ | 3 | 2 | 2 | | 2 | 5 | 7 |
| **** | | | | | | | | |
| sum | | 3 | 3 | 14 | 5 | 2 | 23 | 25 |
| 1995 | LONGLINE | 1 | 1 | | | | 2 | 2 |
| | OTB 0-3 | 13 | 3 | 6 | 9 | | 31 | 31 |
| | OTB 4+ | 2 | 2 | 2 | | 2 | 4 | 6 |
| **** | | | | | | | | |
| sum | | 16 | 6 | 8 | 9 | 2 | 37 | 39 |
| 1996 | LONGLINE | 1 | | | | | 1 | 1 |
| | OTB 0-3 | 18 | | 5 | 7 | 7 | 23 | 30 |
| | OTB 4+ | 1 | 1 | | | | 2 | 2 |
| **** | | | | | | | | |
| sum | | 20 | 1 | 5 | 7 | 7 | 26 | 33 |
| 1997 | OTB 0-3 | 6 | 8 | 3 | 17 | 3 | 31 | 34 |
| | OTB 4+ | 1 | 2 | | | | 3 | 3 |
| **** | | | | | | | | |
| sum | | 7 | 10 | 3 | 17 | 3 | 34 | 37 |
| 1998 | OTB 0-3 | 4 | 6 | 1 | 20 | 1 | 30 | 31 |
| | OTB 4+ | | | | 1 | | 1 | 1 |
| **** | | | | | | | | |
| sum | | 4 | 6 | 1 | 21 | 1 | 31 | 32 |
| 1999 | OTB 0-3 | 1 | 4 | | 19 | | 29 | 29 |
| | OTB 4+ | 1 | 1 | | | | 2 | 2 |
| **** | | | | | | | | |
| sum | | 2 | 5 | | 19 | 1 | 31 | 31 |

**Table 9. Number of observer sampled redfish fishing trips used in catch at length from Unit 3 by vessel/gear class and by statistical area, and by Div., 1993-99. Inventory for 1999 is incomplete.**

| year | class | dehkm | ln | o | pqrs | Unit 3 | |
|---|---|---|---|---|---|---|---|
| 1993 | OTB 0-3 | 1 | | 1 | | 2 | |
| | OTB 4+ | | 4 | 3 | | 7 | |
| ***** | | | | | | | |
| sum | | 1 | 4 | 4 | | 9 | |
| 1994 | OTB 0-3 | | | 14 | 3 | 16 | |
| | OTB 4+ | 1 | 7 | 4 | | 10 | |
| ***** | | | | | | | |
| sum | | 1 | 7 | 18 | 3 | 26 | |
| 1995 | OTB 0-3 | 9 | | 2 | 11 | 19 | |
| | OTB 4+ | 2 | 7 | 1 | 2 | 10 | |
| ***** | | | | | | | |
| sum | | 11 | 7 | 3 | 13 | 29 | |
| 1996 | OTB 0-3 | 41 | 2 | 1 | | 41 | |
| | OTB 4+ | 10 | 7 | 1 | 1 | 14 | |
| ***** | | | | | | | |
| sum | | 51 | 9 | 2 | 1 | 55 | |
| 1997 | OTB 0-3 | 37 | 4 | 0 | 0 | 40 | |
| | OTB 4+ | 1 | 5 | 0 | 0 | 6 | |
| ***** | | | | | | | |
| sum | | 38 | 9 | 0 | 0 | 46 | |
| 1998 | OTB 0-3 | 20 | 3 | 1 | 5 | 28 | |
| ***** | | | | | | | |
| sum | | 20 | 3 | 1 | 5 | 28 | |
| 1999 | OTB 0-3 | 1 | 4 | 0 | 16 | 21 | |
| | OTB 4+ | 1 | 1 | 0 | 3 | 5 | |
| ***** | | | | | | | |
| sum | | 2 | 5 | 0 | 19 | 26 | (to July) |

**Table 10. Tonnes of sampled catch used to construct catch at length, by source, statistical area, and year for period 1993-99. Tons of sampled catch for 1999 is incomplete.**

| Port Samples year | dehkm | ln | o | pqrs | total | Observer Samples dehkm | ln | o | pqrs | total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1993 | .4 | 6.3 | 72.0 | 20.7 | 99.4 | 16.1 | 33.2 | 243.9 | .0 | 293.2 | |
| 1994 | 85.3 | 67.7 | 279.4 | 33.3 | 465.7 | 15.2 | 89.7 | 218.9 | 28.5 | 352.3 | |
| 1995 | 189.8 | 43.9 | 132.0 | 79.0 | 444.8 | 132.0 | 32.8 | 16.7 | 97.5 | 279.0 | |
| 1996 | 364.1 | .5 | 57.1 | 35.8 | 457.5 | 1045.7 | 27.6 | 35.7 | .5 | 1109.5 | |
| 1997 | 90.8 | 127.5 | 2.5 | 294.5 | 515.4 | 539.5 | 37.2 | .0 | .0 | 576.7 | |
| 1998 | 47.5 | 43.3 | 10.8 | 249.4 | 351.0 | 206.1 | 45.6 | 12.2 | 59.4 | 323.4 | |
| 1999 | 14.8 | 33.2 | .0 | 297.5 | 345.5 | 24.0 | 4.8 | .0 | 144.6 | 173.5 | (to July) |

**Table 11. Percent bycatch of other groundfish species by the Unit 3 redfish fishery by year and species for the period 1989-99.**

| | Catfish | Cod | Cusk | Flatfish | Haddock | Halibut | Pollock | Silver Hake | White Hake |
|---|---|---|---|---|---|---|---|---|---|
| 1989 | 0.1 | 2.3 | 0.1 | 0.7 | 1.5 | 0.1 | 4.1 | 0.0 | 0.9 |
| 1990 | 0.0 | 2.8 | 0.1 | 0.4 | 1.0 | 0.0 | 7.4 | 0.0 | 0.6 |
| 1991 | 0.1 | 4.9 | 0.1 | 0.4 | 0.7 | 0.0 | 6.7 | 0.0 | 0.2 |
| 1992 | 0.1 | 4.2 | 0.0 | 1.0 | 1.1 | 0.1 | 4.7 | 0.0 | 0.5 |
| 1993 | 0.1 | 3.1 | 0.4 | 0.4 | 0.6 | 0.0 | 5.9 | 0.0 | 1.8 |
| 1994 | 0.1 | 2.9 | 0.5 | 0.3 | 0.9 | 0.1 | 4.7 | 0.0 | 2.1 |
| 1995 | 0.1 | 1.8 | 0.5 | 0.3 | 0.8 | 0.0 | 6.2 | 0.0 | 1.5 |
| 1996 | 0.1 | 2.5 | 0.2 | 0.4 | 1.4 | 0.0 | 6.4 | 0.2 | 1.5 |
| 1997 | 0.1 | 2.3 | 0.3 | 0.3 | 1.6 | 0.1 | 5.9 | 0.0 | 1.2 |
| 1998 | 0.1 | 2.5 | 0.5 | 0.5 | 2.4 | 0.2 | 7.7 | 0.0 | 1.4 |
| 1999 | 0.1 | 2.4 | 0.5 | 0.7 | 3.6 | 0.1 | 8.1 | 0.1 | 2.2 |

**Table 12. Percent bycatch of other groundfish species by the Unit 3 redfish fishery by unit area and species for 1998.**

| SPECIES | dehkm | ln | o | pqrs | total |
|---|---|---|---|---|---|
| Pollock | 4.8 | 2.8 | 1.8 | 9.2 | 7.7 |
| Cod | 1.0 | .5 | 2.0 | 3.0 | 2.5 |
| Haddock | 2.9 | .4 | 1.7 | 2.6 | 2.4 |
| White hake | .0 | 3.5 | .1 | 1.5 | 1.4 |
| Flatfish | .4 | 1.0 | .4 | .5 | .5 |
| Cusk | .0 | 1.1 | .0 | .6 | .5 |
| Halibut | .1 | 1.8 | .0 | .0 | .2 |
| sum | 9.2 | 11.1 | 6.0 | 17.4 | 15.3 |

**Table 13. Percent bycatch of other groundfish species by the Unit 3 redfish fishery by unit area and species for 1999 (to Oct).**

| SPECIES | dehkm | ln | o | pqrs | total |
|---|---|---|---|---|---|
| Pollock | 3.1 | 4.3 | 6.6 | 10.1 | 8.1 |
| Haddock | 3.0 | .6 | 7.4 | 4.4 | 3.6 |
| Cod | .7 | .3 | 2.0 | 3.3 | 2.4 |
| White hak | .0 | 3.0 | .1 | 2.7 | 2.2 |
| Flatfish | .1 | .2 | 1.0 | .9 | .7 |
| Cusk | .0 | 1.7 | .0 | .5 | .5 |
| Halibut | .1 | 1.0 | .0 | .0 | .1 |
| Catfish | .1 | .1 | .6 | .1 | .1 |
| Silver ha | .0 | .0 | .0 | .2 | .1 |
| sum | 7.1 | 11.2 | 17.7 | 22.2 | 17.8 |

**Table 14. Bycatch of other species (>500 kg total catch) during redfish directed tows as recorded by observers program during 1998 and 1999 (to Oct)**

year= 98

| species | dehkm | ln | o | pqrs | Unit3 | dehkm | ln | o | pqrs | Unit3 |
|---|---|---|---|---|---|---|---|---|---|---|
| redfish | 209.81 | 46.21 | 12.23 | 60.39 | 328.64 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| pollock | 15.13 | 1.21 | .01 | 16.51 | 32.87 | 7.21 | 2.62 | .09 | 27.34 | 10.00 |
| haddock | 7.00 | | .15 | 1.60 | 8.75 | 3.34 | | 1.21 | 2.65 | 2.66 |
| cod | 2.22 | .03 | .17 | 1.57 | 3.99 | 1.06 | .06 | 1.39 | 2.60 | 1.21 |
| monkfish | 1.11 | 2.47 | | .11 | 3.68 | .53 | 5.34 | | .18 | 1.12 |
| smooth skate | .00 | .01 | .07 | 3.05 | 3.13 | .00 | .02 | .53 | 5.05 | .95 |
| spiny dogfish | .89 | | | 1.69 | 2.58 | .42 | | | 2.80 | .78 |
| silver hake | 1.89 | .11 | | | 2.00 | .90 | .24 | | | .61 |
| white hake | .28 | .62 | | .94 | 1.84 | .13 | 1.34 | | 1.56 | .56 |
| basking shark | | 1.50 | | | 1.50 | | 3.25 | | | .46 |
| halibut | .45 | .58 | | .04 | 1.06 | .21 | 1.26 | | .06 | .32 |
| herring | .14 | | .00 | .92 | 1.06 | .07 | | .01 | 1.52 | .32 |
| witch flounder | .63 | .23 | | .08 | .93 | .30 | .49 | | .13 | .28 |
| thorny skate | .49 | .00 | | .26 | .75 | .23 | .01 | | .42 | .23 |

year= 99

| species | dehkm | ln | o | pqrs | Unit3 | dehkm | ln | o | pqrs | Unit3 |
|---|---|---|---|---|---|---|---|---|---|---|
| redfish | 58.10 | 8.51 | | 144.61 | 211.22 | 100.00 | 100.00 | | 100.00 | 100.00 |
| pollock | 2.51 | 1.59 | | 36.84 | 40.94 | 4.31 | 18.74 | | 25.48 | 19.38 |
| spiny dogfish | .11 | .02 | | 28.91 | 29.03 | .18 | .24 | | 19.99 | 13.74 |
| cod | .53 | .01 | | 4.48 | 5.02 | .92 | .06 | | 3.10 | 2.37 |
| haddock | 2.75 | .00 | | 1.22 | 3.97 | 4.73 | .02 | | .84 | 1.88 |
| white hake | | .08 | | 1.18 | 1.27 | | .96 | | .82 | .60 |
| monkfish | .28 | .31 | | .18 | .76 | .49 | 3.61 | | .12 | .36 |

**Table 15. Unit 3 redfish fishing effort in hours and days by small otter trawlers during the period 1989 to 1999.**

| year | hrs | days | hrs/day | |
|---|---|---|---|---|
| 1989 | 1833 | 313 | 6 | |
| 1990 | 879 | 108 | 8 | |
| 1991 | 736 | 98 | 8 | |
| 1992 | 1421 | 149 | 10 | |
| 1993 | 5095 | 541 | 9 | |
| 1994 | 9759 | 895 | 11 | |
| 1995 | 12656 | 1176 | 11 | |
| 1996 | 9983 | 1121 | 9 | |
| 1997 | 16228 | 1444 | 11 | |
| 1998 | 18314 | 1479 | 12 | |
| 1999 | 12108 | 1030 | 12 | (to Oct) |
| avg | 8092 | 759 | 10 | |

**Table 16. Unit 3 redfish fishing effort in hours and days by large otter trawlers during the period 1989 to 1999.**

| year | hrs | days | hrs/day | |
|---|---|---|---|---|
| 1989 | 1310 | 157 | 8 | |
| 1990 | 684 | 165 | 4 | |
| 1991 | 1410 | 158 | 9 | |
| 1992 | 1686 | 189 | 9 | |
| 1993 | 1984 | 215 | 9 | |
| 1994 | 1861 | 184 | 10 | |
| 1995 | 1622 | 195 | 8 | |
| 1996 | 732 | 88 | 8 | |
| 1997 | 282 | 26 | 11 | |
| 1998 | 176 | 13 | 14 | |
| 1999 | 522 | 43 | 12 | (to Oct) |
| avg | 1115 | 130 | 9 | |

**Table 17.Survey biomass (thousands of tons) and abundance (numbers per standard tow) estimates for unit 3 redfish from Scotia Fundy Summer Research Survey.**

| year | biomass | numbers |
|---|---|---|
| 1982 | 72.7 | 76.5 |
| 1983 | 122.8 | 121.3 |
| 1984 | 106.0 | 89.7 |
| 1985 | 17.0 | 18.0 |
| 1986 | 93.2 | 71.7 |
| 1987 | 63.1 | 57.5 |
| 1988 | 83.4 | 91.1 |
| 1989 | 27.7 | 29.0 |
| 1990 | 61.9 | 81.6 |
| 1991 | 24.9 | 38.4 |
| 1992 | 116.0 | 118.8 |
| 1993 | 69.6 | 75.5 |
| 1994 | 50.4 | 76.3 |
| 1995 | 45.6 | 61.1 |
| 1996 | 50.1 | 79.7 |
| 1997 | 120.6 | 209.2 |
| 1998 | 24.7 | 45.9 |
| 1999 | 83.6 | 120.7 |
| avg | 68.5 | 81.2 |

**Table 18. Trawl units, stratified total weight of redfish per tow (kg), total numbers of redfish per tow, and average weigth (kg) for summer 4X Mobile Industry (ITQ) and DFO groundfish research (RV) surveys in Div 4x, 1995-99. For A) all strata surveyed by the industry, B) strata in 4Xo, C) stratra in 4Xpqrs, and D) strata sampled in both surveys in all years. (Strata 483 was not sampled by industry survey, 499 was not sampled by research survey, 471, 482, and 484 were not sampled by ITQ survey in 1995, 478 was not sampled by ITQ survey 1995 and 1998, and numbers were not recorded for some sets in ITQ survey for 1997.)**

a) All industry survey strata (460, 461, 470-482, 484-495, 499)

| Yr | ITQ Units | TotWgt | TotNo | AvgWgt | RV Units | TotWgt | TotNo | AvgWgt |
|---|---|---|---|---|---|---|---|---|
| 1995 | 1490179 | 20.36 | 88.73 | .23 | 1739064 | 25.19 | 91.09 | .28 |
| 1996 | 1989052 | 23.92 | 130.34 | .18 | 1739064 | 28.69 | 122.76 | .23 |
| 1997 | 1989052 | 33.21 | 175.02 | .19 | 1739064 | 68.80 | 324.82 | .21 |
| 1998 | 1953206 | 29.45 | 130.85 | .23 | 1739064 | 12.93 | 64.07 | .20 |
| 1999 | 1989052 | 52.36 | 286.22 | .18 | 1739064 | 47.21 | 181.62 | .26 |

b) 4X strata (470-491, 495)

| Yr | ITQ Units | TotWgt | TotNo | AvgWgt | RV Units | TotWgt | TotNo | AvgWgt |
|---|---|---|---|---|---|---|---|---|
| 1995 | 1142400 | 27.77 | 121.00 | .23 | 1572463 | 28.22 | 101.01 | .28 |
| 1996 | 1527380 | 32.58 | 177.81 | .18 | 1572463 | 19.27 | 98.52 | .20 |
| 1997 | 1527380 | 45.28 | 239.10 | .19 | 1572463 | 72.65 | 354.81 | .20 |
| 1998 | 1507635 | 38.38 | 178.72 | .21 | 1572463 | 15.21 | 71.19 | .21 |
| 1999 | 1527380 | 71.43 | 390.67 | .18 | 1572463 | 48.50 | 189.11 | .26 |

c) 4Xo strata (474-481)

| Yr | ITQ Units | TotWgt | TotNo | AvgWgt | RV Units | TotWgt | TotNo | AvgWgt |
|---|---|---|---|---|---|---|---|---|
| 1995 | 366507 | 97.27 | 427.35 | .23 | 366507 | 103.34 | 346.77 | .30 |
| 1996 | 366507 | 90.21 | 563.77 | .16 | 366507 | 49.50 | 224.73 | .22 |
| 1997 | 366507 | 164.10 | 889.76 | .18 | 366507 | 224.05 | 1268.44 | .18 |
| 1998 | 366507 | 87.07 | 498.44 | .17 | 366507 | 14.67 | 67.21 | .22 |
| 1999 | 366507 | 218.96 | 1236.79 | .18 | 366507 | 136.13 | 553.85 | .25 |

d) 4Xpqrs strata (482, 484-495)

| Yr | ITQ Units | TotWgt | TotNo | AvgWgt | RV Units | TotWgt | TotNo | AvgWgt |
|---|---|---|---|---|---|---|---|---|
| 1995 | 465231 | 3.66 | 17.15 | .21 | 745386 | 2.12 | 4.48 | .47 |
| 1996 | 745386 | 18.98 | 74.55 | .25 | 745386 | 4.71 | 21.82 | .22 |
| 1997 | 745386 | 9.62 | 43.23 | .22 | 745386 | 35.22 | 93.20 | .38 |
| 1998 | 745386 | 20.72 | 46.72 | .44 | 745386 | 3.66 | 7.56 | .48 |
| 1999 | 745386 | 36.82 | 184.77 | .20 | 745386 | 29.91 | 98.72 | .30 |

e) Strata common to both surveys in all year (470, 472-477, 480, 485-495)

| Yr | ITQ Units | TotWgt | TotNo | AvgWgt | RV Units | TotWgt | TotNo | AvgWgt |
|---|---|---|---|---|---|---|---|---|
| 1995 | 1142400 | 37.13 | 161.78 | .23 | 1142400 | 37.87 | 137.18 | .28 |
| 1996 | 1142400 | 36.67 | 217.27 | .17 | 1142400 | 25.07 | 128.60 | .19 |
| 1997 | 1142400 | 56.62 | 302.42 | .19 | 1142400 | 95.86 | 479.37 | .20 |
| 1998 | 1142400 | 44.17 | 231.27 | .19 | 1142400 | 19.21 | 95.42 | .20 |
| 1999 | 1142400 | 86.65 | 490.78 | .18 | 1142400 | 53.17 | 209.47 | .25 |

**Table 19. Harvest rate (5yr avg survey biomass/commercial landings * 100%) of Unit 3 redfish for the period 1982 to 1998.**

| year | biomass | landings | harvest rate (%) |
|---|---|---|---|
| 1986 | 82.3 | 6.7 | 8.1 |
| 1987 | 80.4 | 6.1 | 7.6 |
| 1988 | 72.5 | 3.9 | 5.4 |
| 1989 | 56.9 | 3.4 | 6.0 |
| 1990 | 65.9 | 2.4 | 3.6 |
| 1991 | 52.2 | 2.1 | 3.9 |
| 1992 | 62.8 | 2.5 | 4.0 |
| 1993 | 60.0 | 5.3 | 8.8 |
| 1994 | 64.6 | 5.2 | 8.0 |
| 1995 | 61.3 | 4.9 | 7.9 |
| 1996 | 66.3 | 4.8 | 7.2 |
| 1997 | 67.3 | 6.4 | 9.4 |
| 1998 | 58.3 | 5.8 | 10.1 |
| 1999 | 64.9 | - | - |
| 1994-98 avg | 63.6 | 5.4 | 8.5 |
| 1986-98 avg | 65.4 | 4.6 | 7.0 |

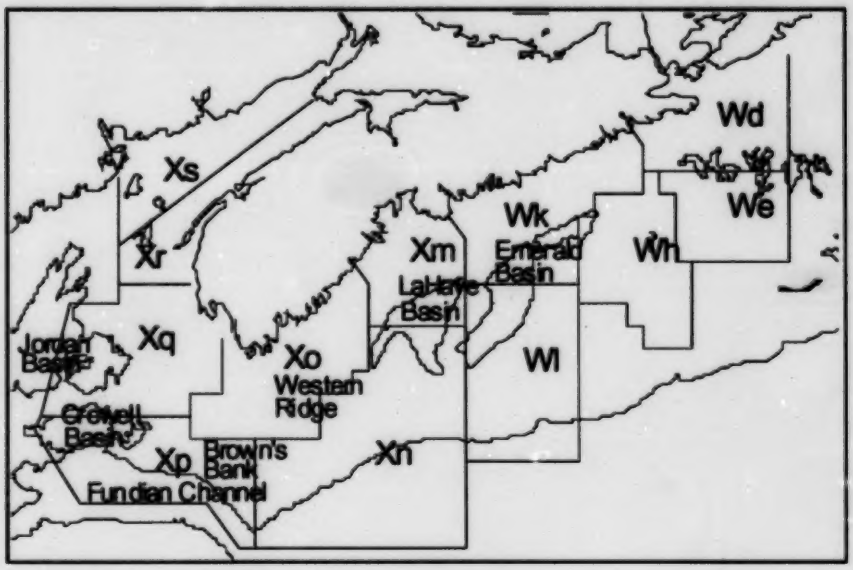


**Figure 1. Unit 3 Management area for redfish.**

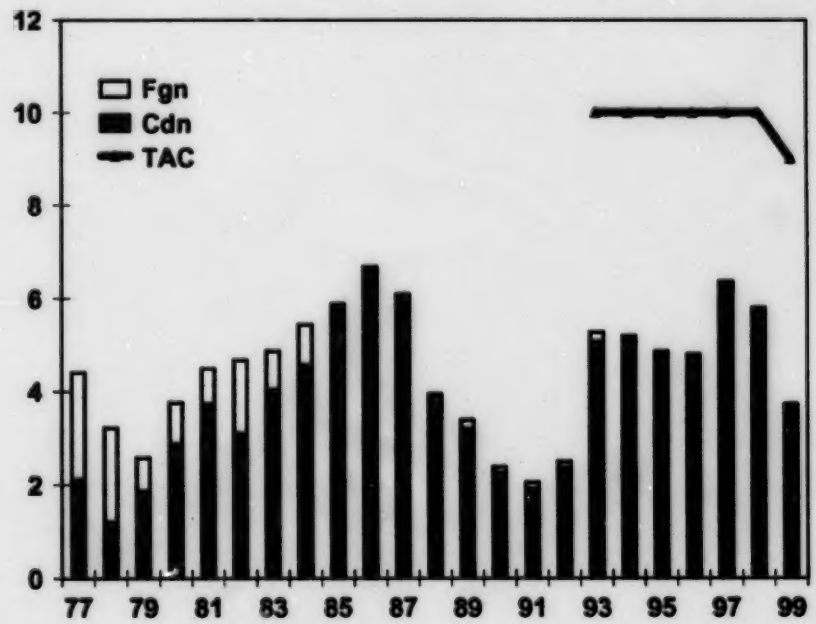


**Figure 2. Canadian and Foreign Landings and TAC in thousands of tons for Unit 3 redfish during the period 1977-99 (to Oct).**

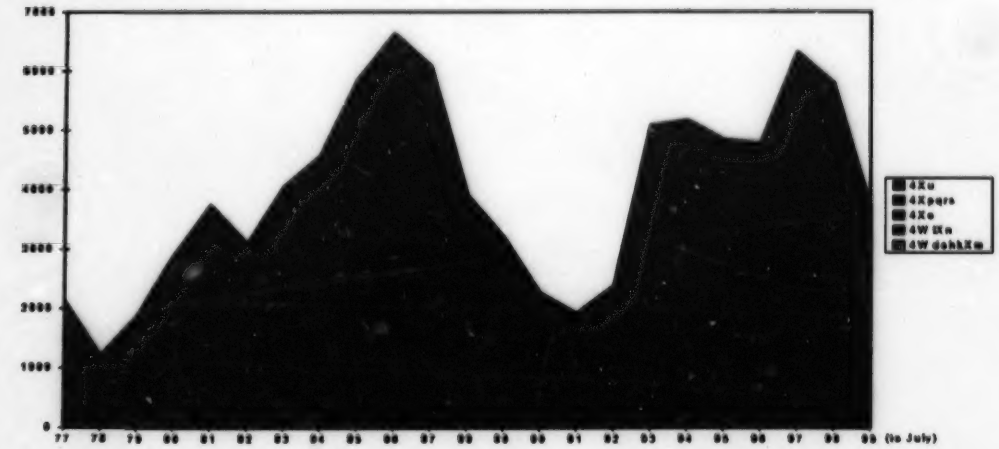

**Figure 3. Unit 3 redfish Canadian landings (tons) by year and statistical area for 1977-99 (to Oct).**

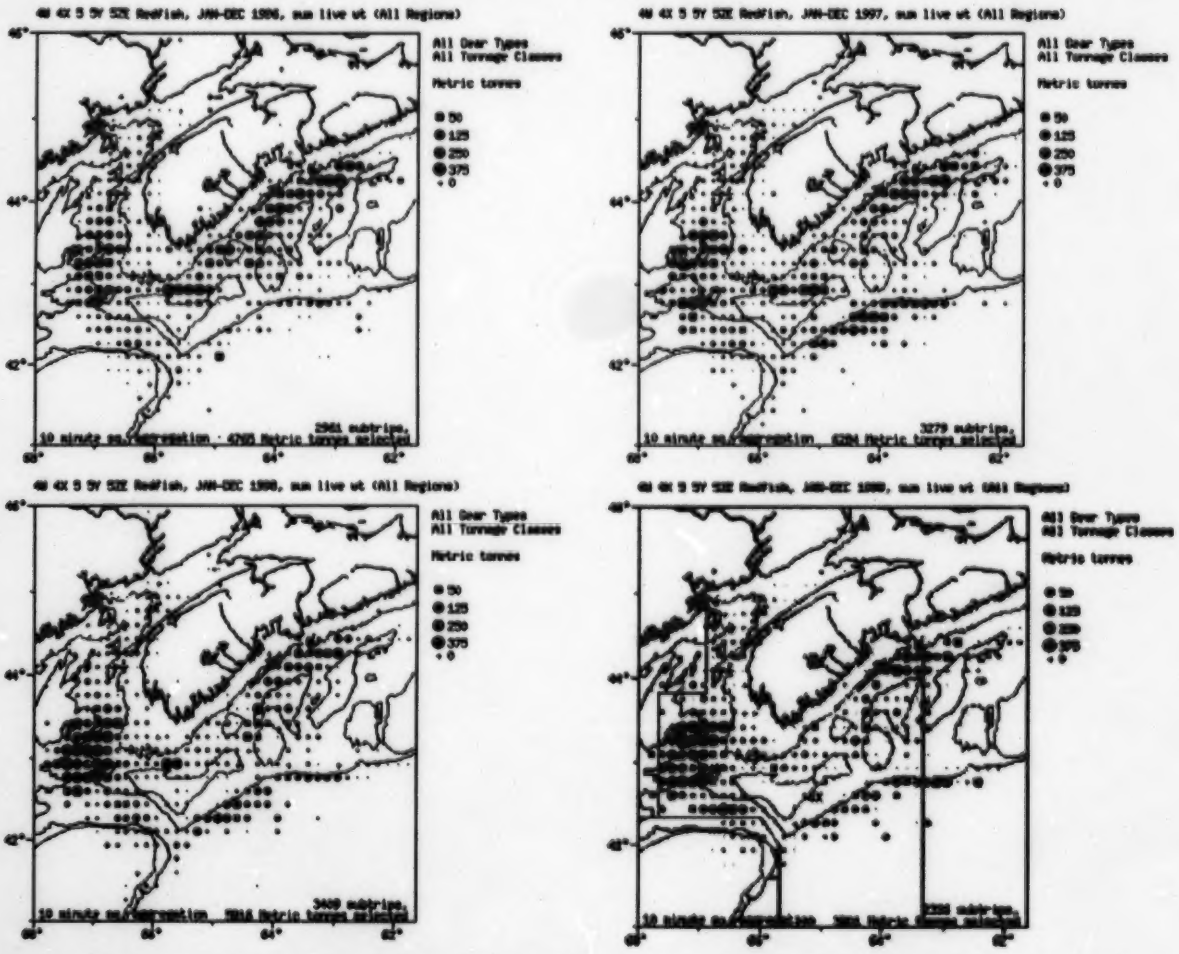

**Figure 4. Geogrpahical distribution of redfish catch (from logbooks) by the Canadian fleet in Nafo Divisons 4WX and subarea 5 during the period January 1996 to October 1999.**

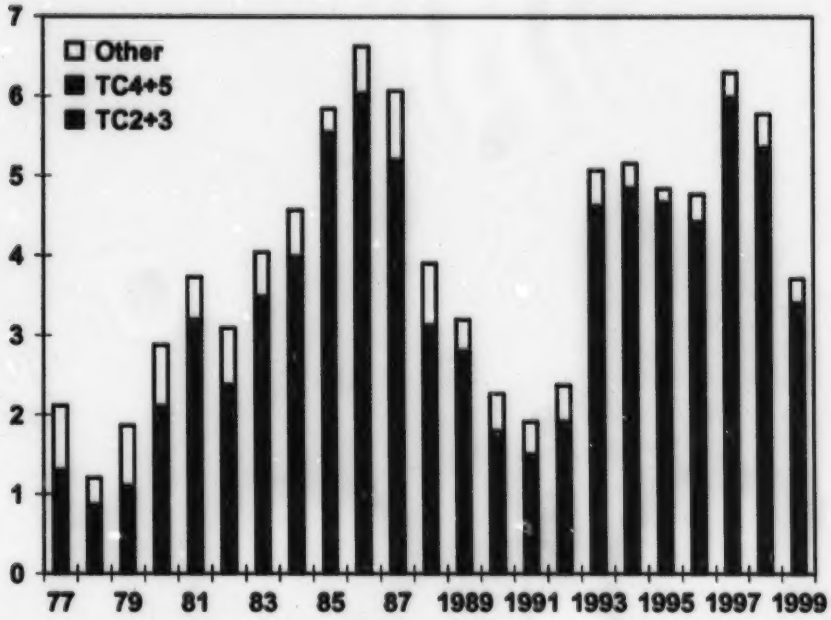


**Figure 5. Unit 3 redfish catch by year and vessel type (main species redfish trips only) and other catches in thousands of tons during the period 1977-99 (to Oct).**

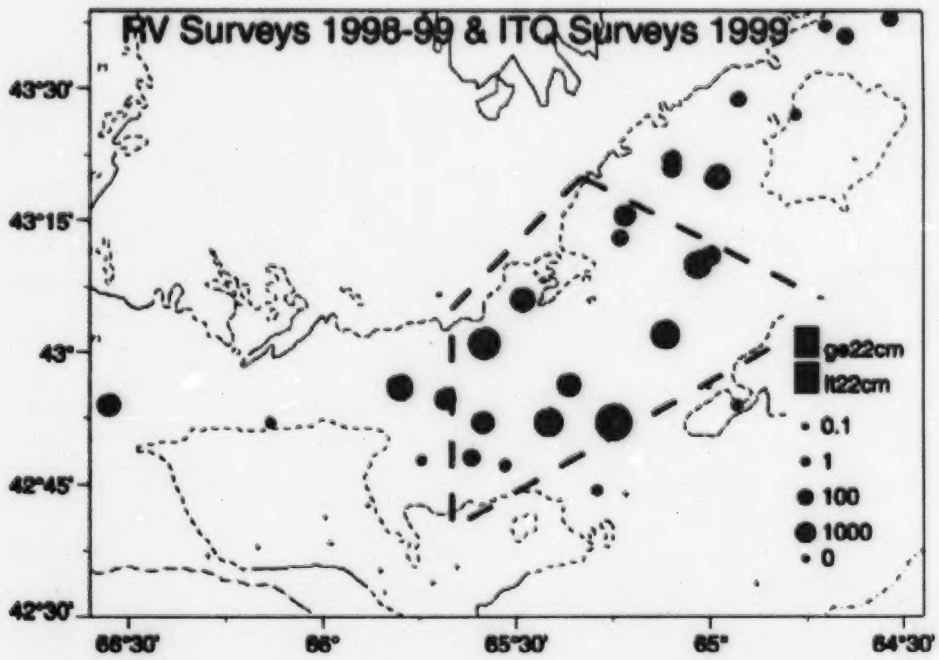


**Figure 6. ITQ and research vessel survey catches showing numbers of large fish (greater than or equal 22 cm / black portion of the pie ) vs. small fish ( less than 22 cm / grey portion of the pie ) in the Unit 3 small fish closures changes during 1998 and 1999.**

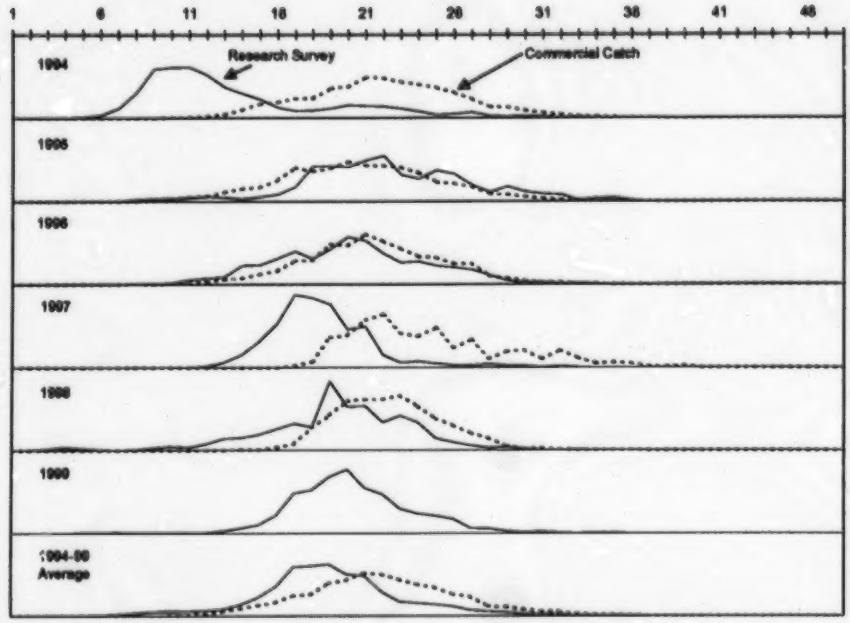


**Figure 7. Redfish research survey (solid) and commercial catch (dashed) size composition (%) from Roseway Basin and Western Ridge (4Xo) for the period 1994-99 (to July).**

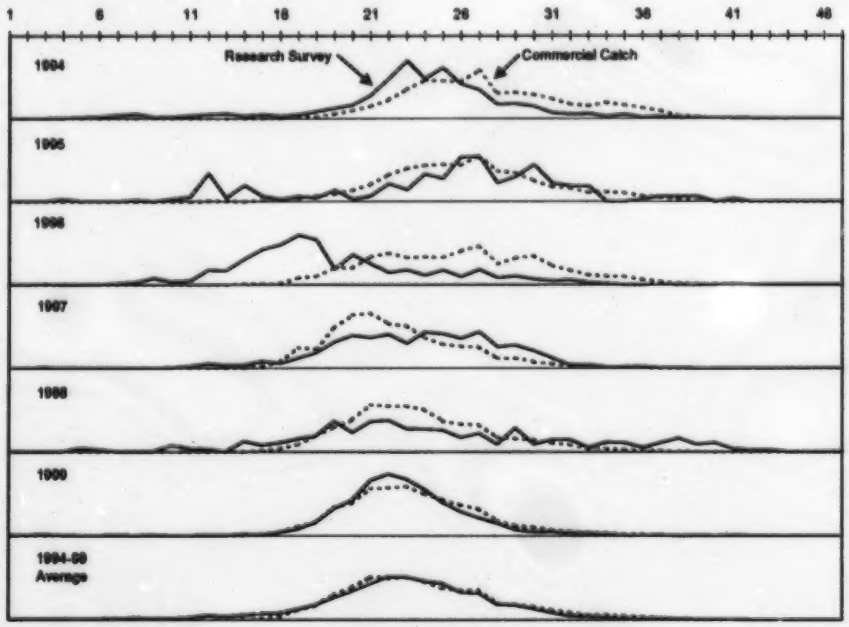


**Figure 8. Redfish research survey (solid) and commercial catch (dashed) size composition (%) Crowell and Jordan Basins (4Xpqrs) for the period 1994-99 (to July).**

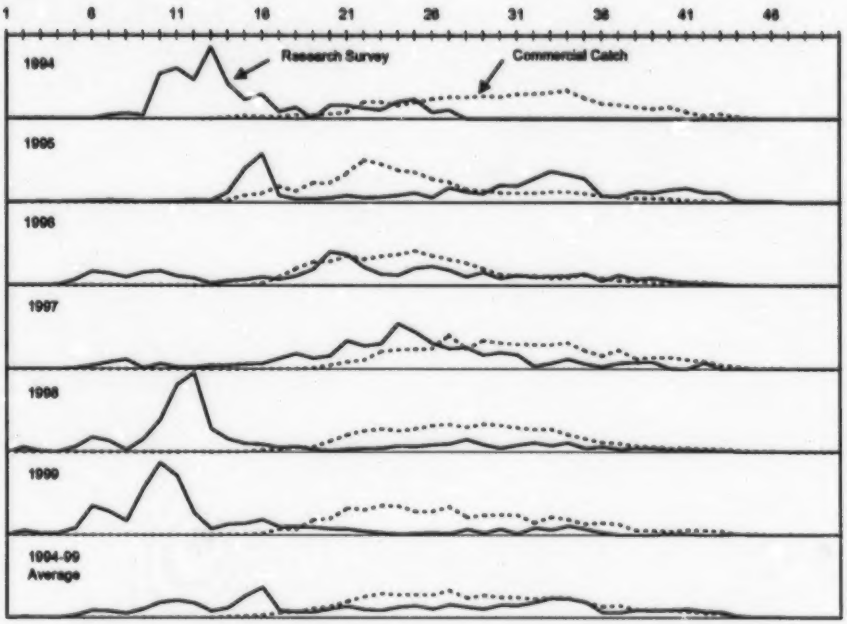


**Figure 9. Redfish research survey (solid) and commercial catch (dashed) size composition (%) from Scotian Shelf Slope (4WlXn) for the period 1994-99 (to July).**

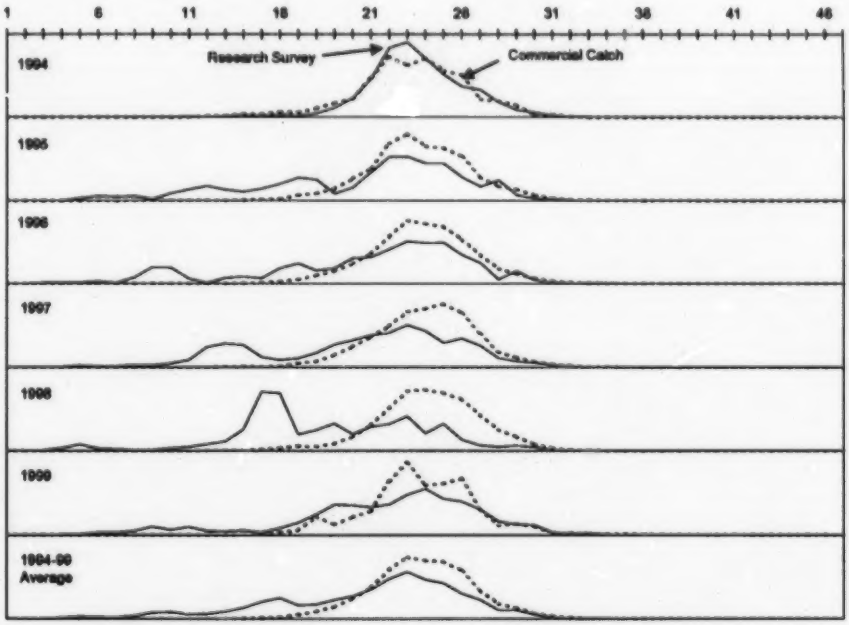


**Figure 10. Redfish research survey (solid) and commercial catch (dashed) size composition (%) from Emerald and La Have Basins (4WdehkXm) for the period 1994-99 (to July).**

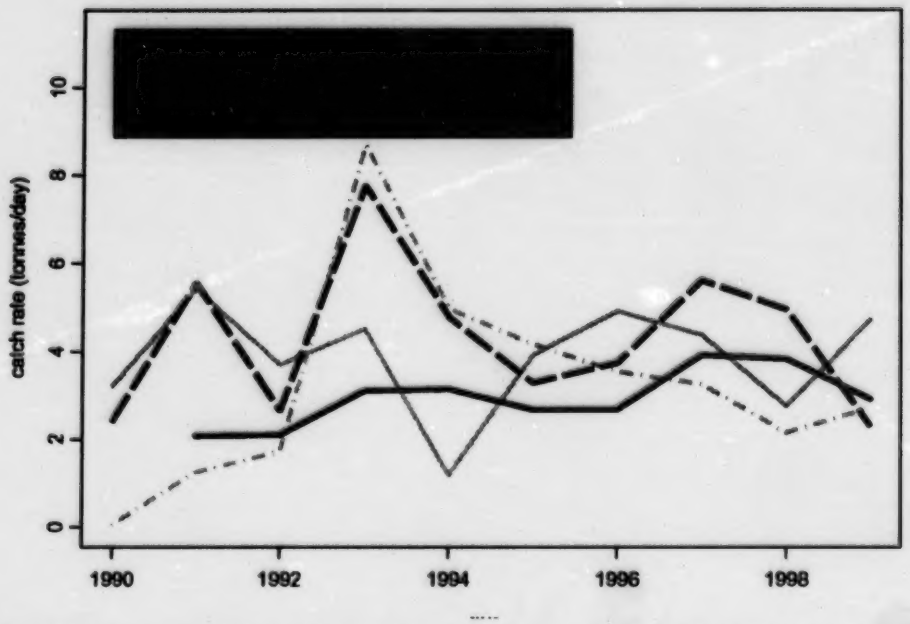


**Figure 11. Small otter trawler redfish catch rates (tonnes per days fished) by fishing location in Unit 3 in the period 1990-99(to Oct)**

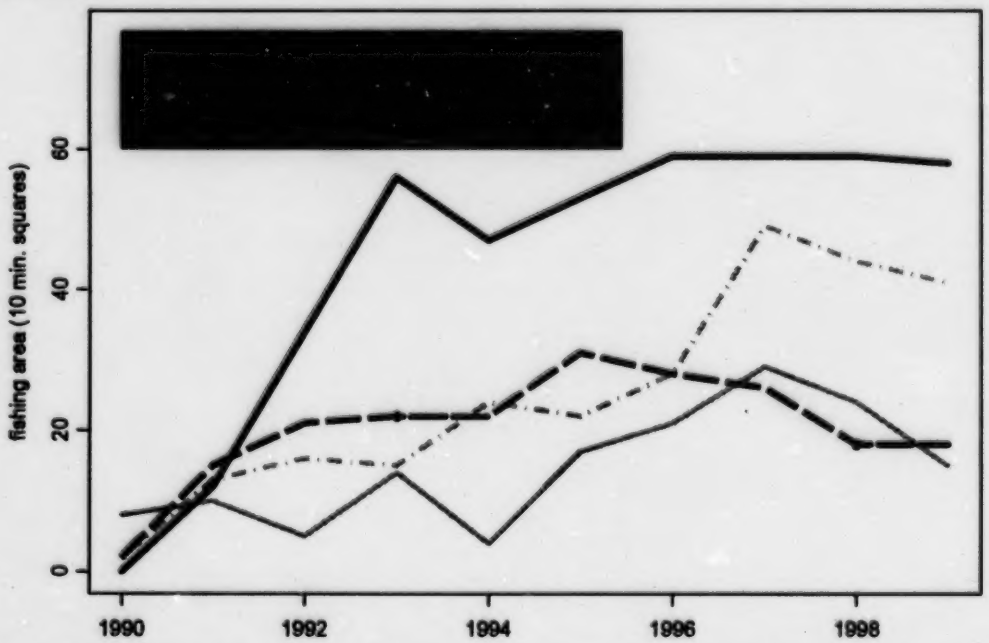


**Figure 12. Area (10 minute squares) occupied by small otter trawlers fishing redfish (main species caught) in Unit 3 for the period 1990-99 (to Oct).**

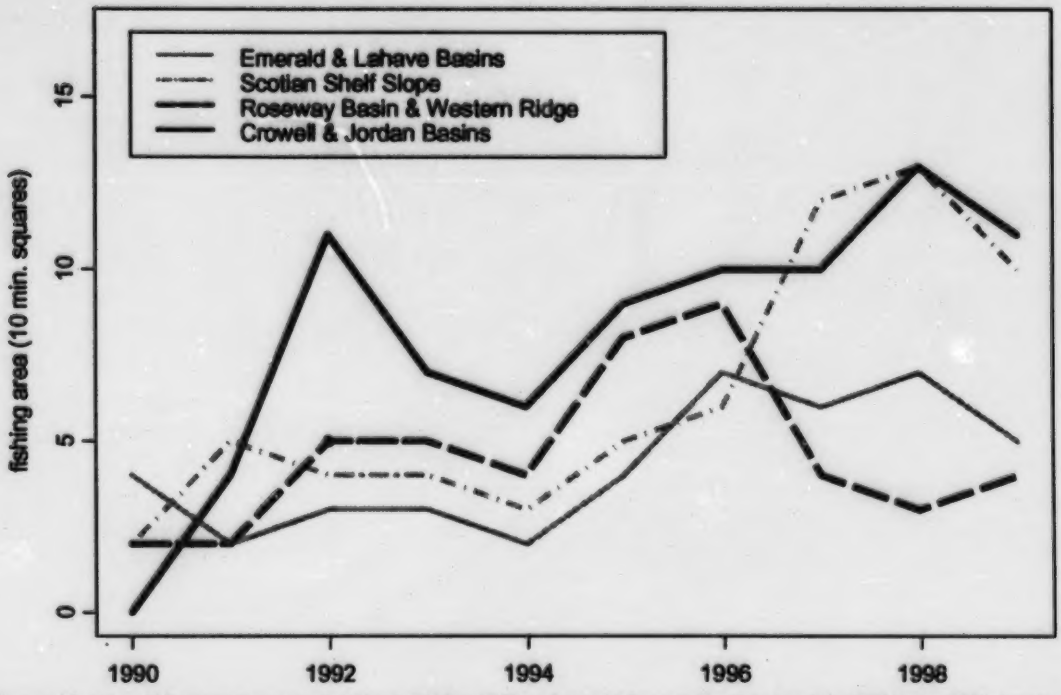


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**Figure 13. Area (10 minute squares) of best fishing (75% of catch) for small otter trawlers fishing redfish (main species caught) in Unit 3 for the period 1990-99 (to Oct).**

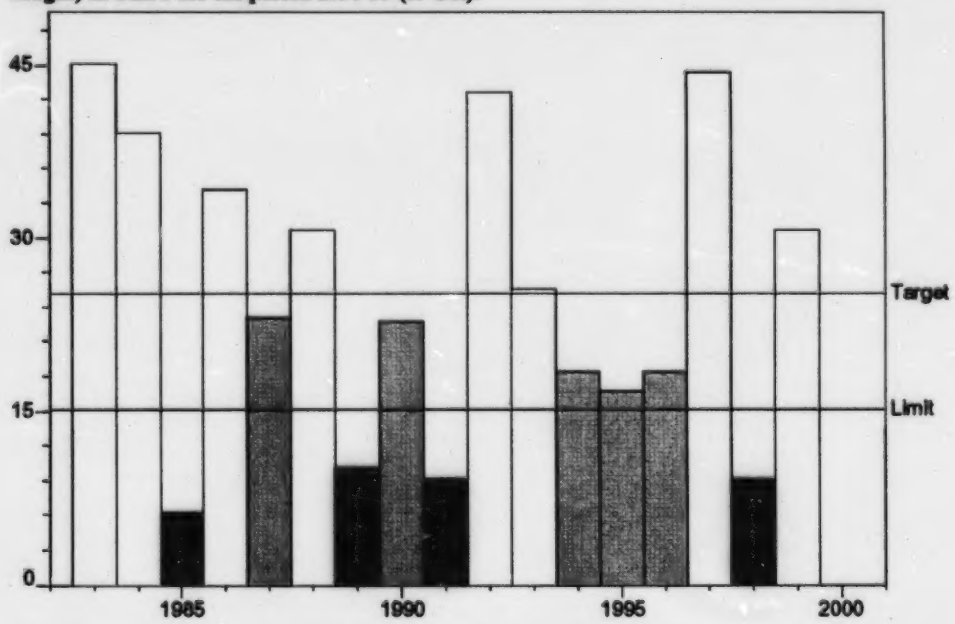


**Figure 14. Unit 3 redfish stratified research survey biomass estimates and precautionary approach target/limits for the period 1983-99.**

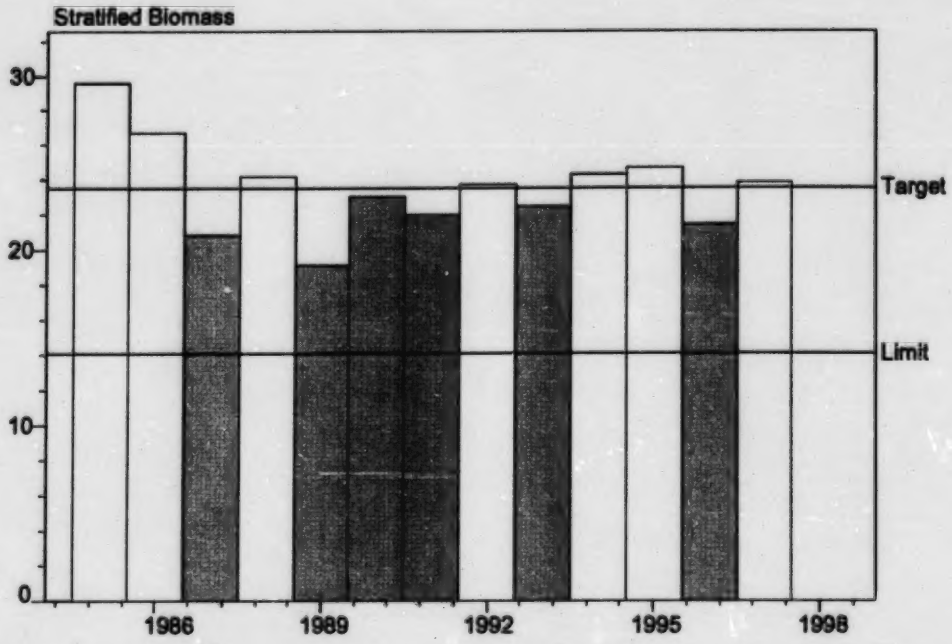


**Figure 15. Unit 3 redfish stratified research survey biomass estimates (5 year moving average) and precautionary approach target/limits for the period 1983-99.**

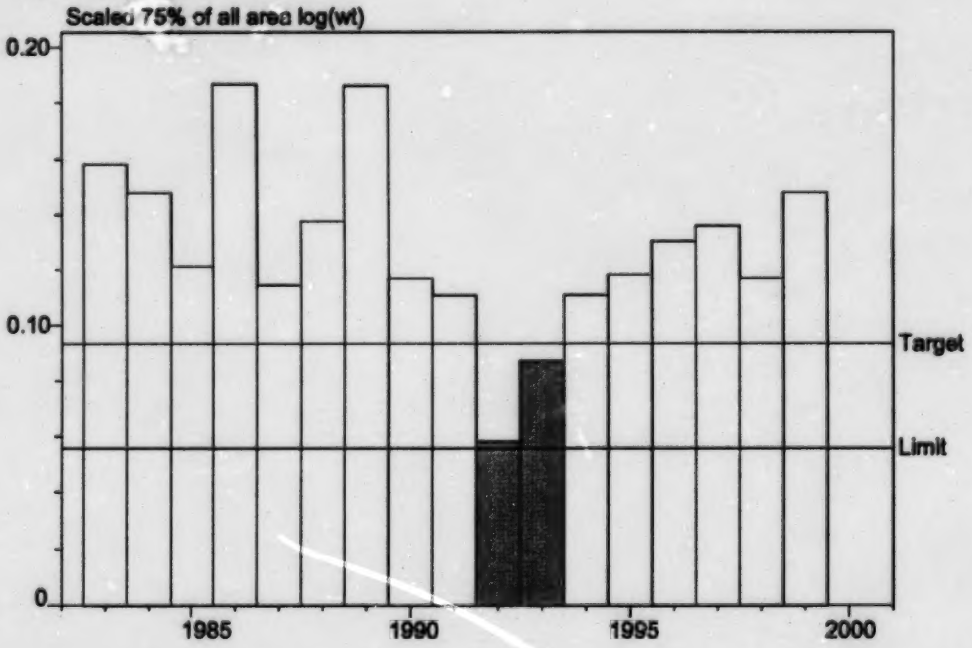


**Figure 16. Proportion of Unit 3 research vessel survey area containing 75% of redfish biomass and precautionary approach target/limits for the period 1983-99.**

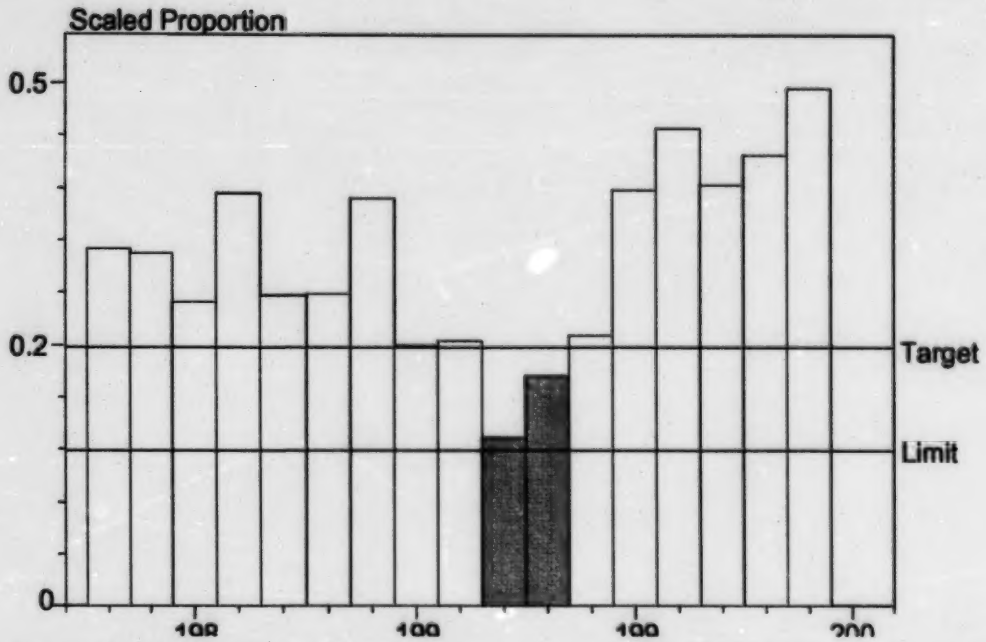


**Figure 17. Proportion of Unit 3 research vessel survey non-zero redfish tows biomass and precautionary approach target/limits for the period 1983-99.**

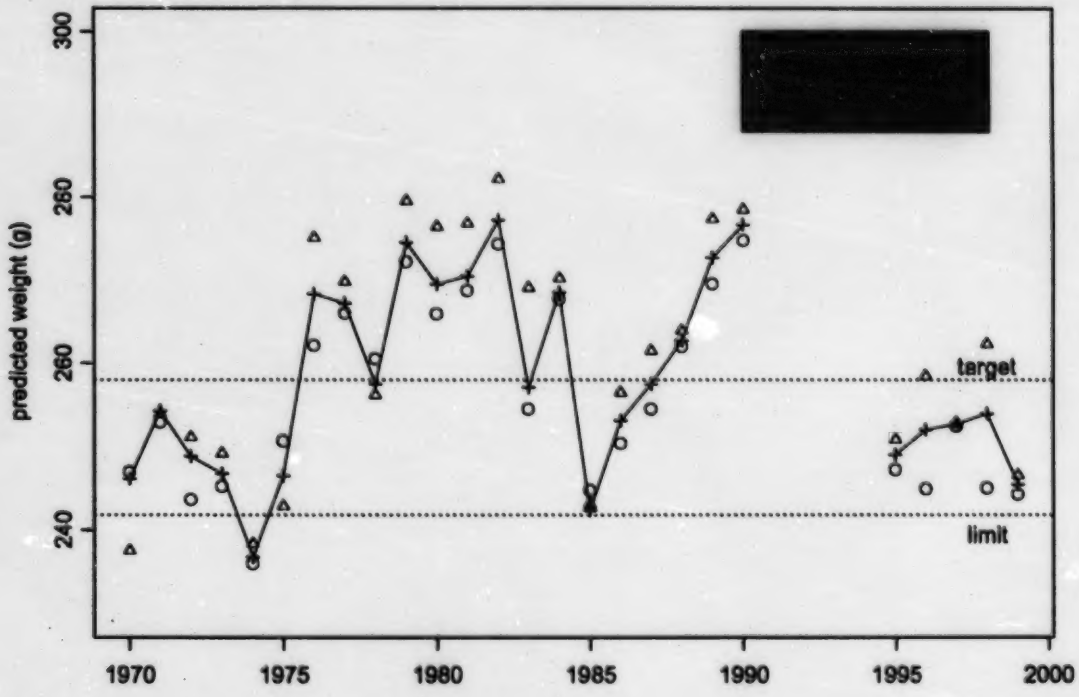


**Figure 18. Condition factor index (predicted weight of a 25 cm redfish) biomass and precautionary approach target/limits for the perid 1970-99 (there was no individual fish weight data for period 1991-94).**

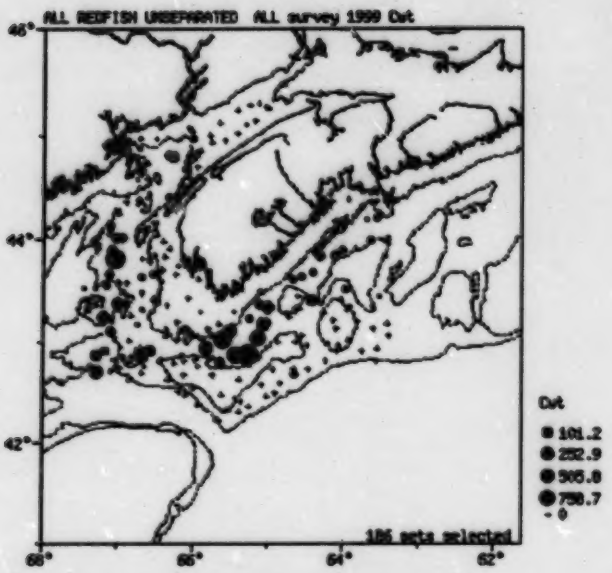


**Figure 19. The distribution of redfish in Div 4X (kg/tow) from ITQ surveys, 1999.**

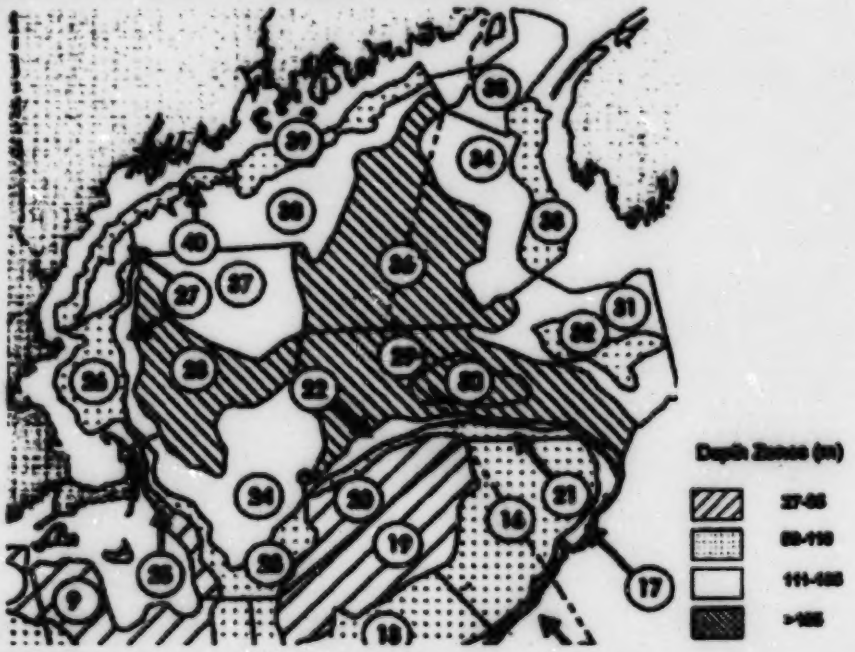


**Figure 20. Sampling strata used on National Marine Fisheries Service Gulf of Maine - Georges Bank bottom trawl surveys.**

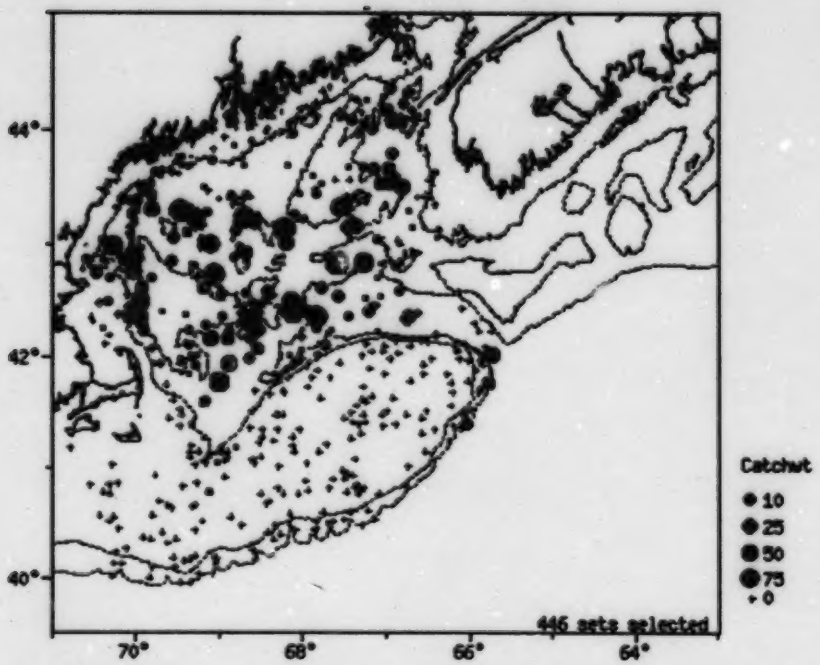


**Figure 21. Distribution (kilograms per tow) of Gulf of Maine - Georges Bank redfish based on National Marine Fisheries Service autumn bottom trawl surveys (all strata surveys), 1996-98.**

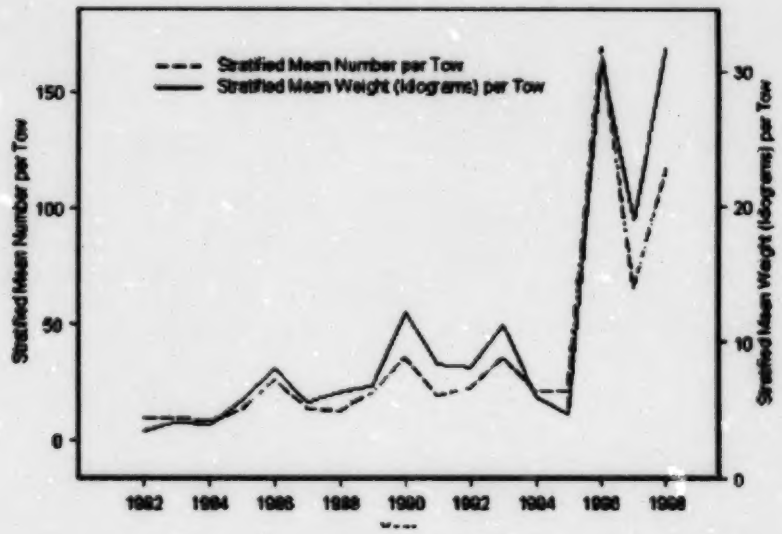


**Figure 22. Abundance (mean number per tow) and biomass (mean weight (kg) per tow of Gulf of Maine - Georges Bank redfish based on National Marine Fisheries Service autumn bottom trawl surveys (strata 24, 26-30, 36-40), 1982-98.**

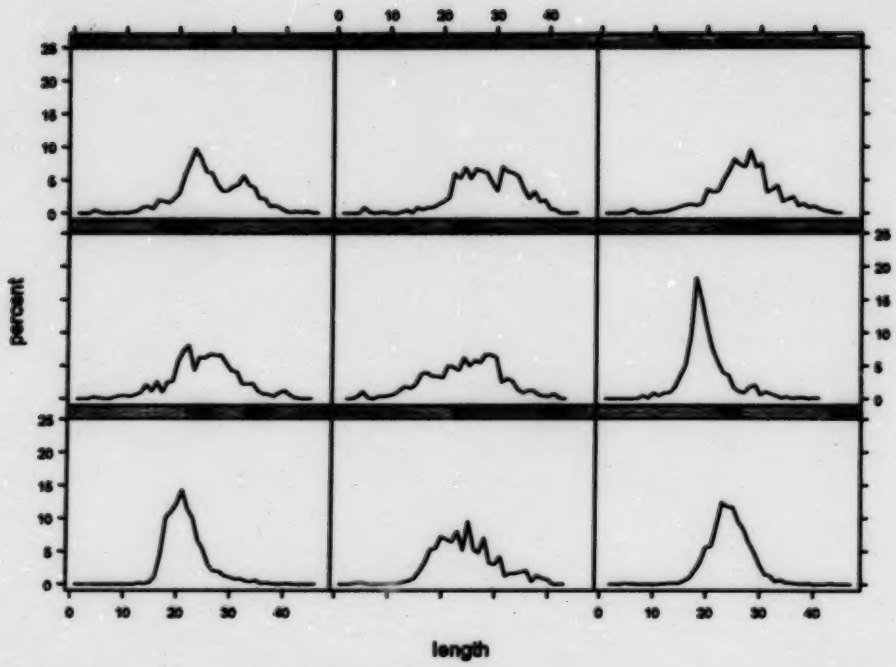


**Figure 23. Size composition (% composition of stratified mean number per tow) of Gulf of Maine - Georges Bank redfish based on National Marine Fisheries Service autumn bottom trawl surveys (strata 24, 26-30, 36-40), 1990-98.**

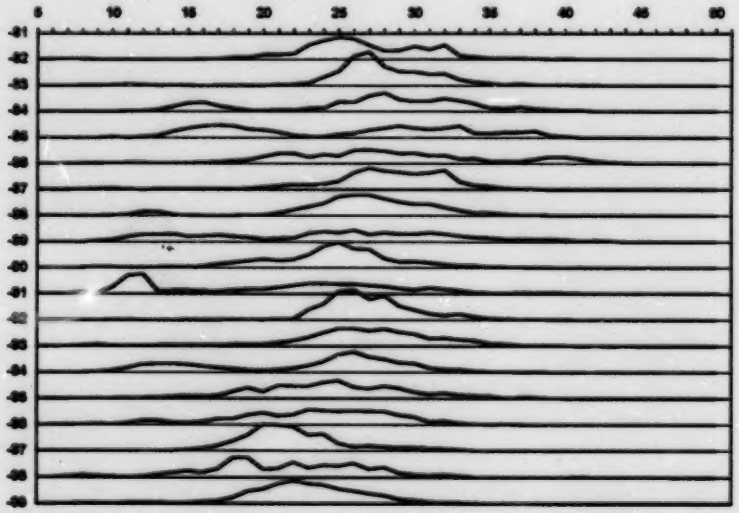

**Figure 24. Size composition of survey catches for Unit 3 redfish from Scotia Fundy Summer Research Vessel Survey (< 200 fm) for the period 1982 to 1999.**

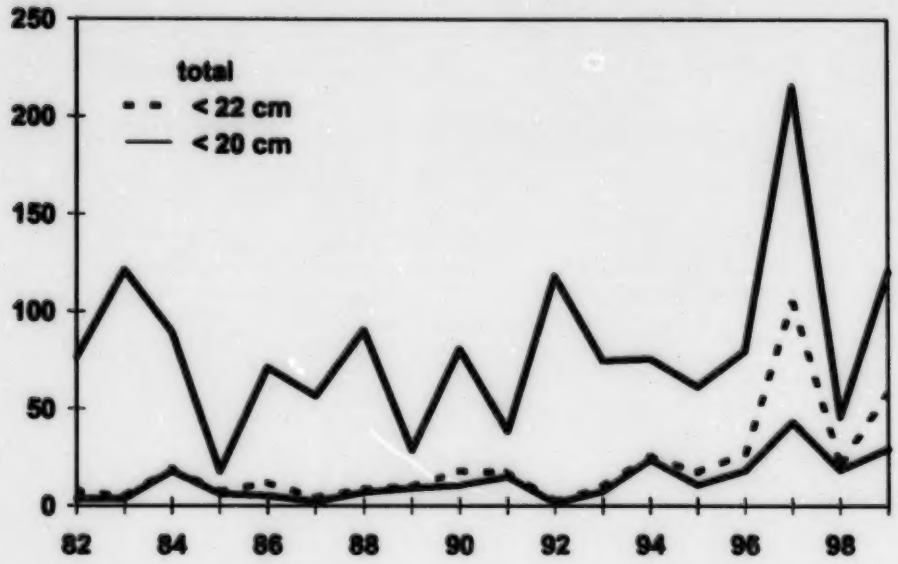


**Figure 25. Abundance of unit 3 redfish by size category from summer surveys for the period 1982 to 1999.**